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Semi-empirical model of middle atmosphere wind from the ground to the lower thermosphere

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Abstract

During recent years, special attention has been paid to understanding the background circulation of the middle atmosphere. Particularly in the mesosphere/lower thermosphere (MLT) region, this has involved including data from a range of new radar measurements. It has also involved the comparison of existing empirical middle atmosphere wind models, such as CIRA-86 and HWM-93 to the new data. This has led to the construction of empirical models of MLT winds such as the Global Empirical Wind Model (GEWM). Further investigations are aimed at the construction of new empirical and semi-empirical wind models of the entire middle atmosphere including these new experimental results. The results of a new wind climatology (0–100 km) are presented here, based upon the GEWM, a reanalysis of stratospheric data, and a numerical model which is used to fill the gap between data from the stratospheric and MLT regions.

Keywords: Winds; Middle atmosphere; Lower thermosphere; Semi-empirical model

1. Introduction

Many attempts have been made to construct empirical wind models of the middle and upper atmosphere including the stratosphere, the mesosphere and the upper mesosphere/lower thermosphere regions. The most widely used models are the COSPAR International Reference Atmosphere 72 (CIRA-72, 1972) and the Fleming et al. (1990) model, which is a part of CIRA-86 model. Since the CIRA models have generally considered regions far above the greatest heights for standard radiosondes, the CIRA-72 model was mainly based on rocket data, including only sparse meteor radar and ionospheric drift data. In the CIRA-86 model, the zonal wind was calculated from the zonally averaged momentum balance equation. The related temperatures for the stratosphere/mesosphere regions were determined from satellite radiance measurements (Barnett and Corney, 1985), and from empirical models of temperature derived from mass spectrometer and incoherent scatter (MSIS-83, Hedin et al., 1991). This method is not, however, a direct technique of wind determination. In addition the reliability of the gradient wind technique for wind derivation is also highly questionable in the 85- to 110-km region, due to the absence of any direct tempera-

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